

Plasma and Thermal Processing of Europa's Surface

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The effects of the intense plasma and thermal processing on the surface of Europa will be briefly reviewed as it relates to potential surface/ocean coupling. Attention will be paid to the chemical processing such as production of oxygen (e.g., Teolis et al. 2017; Spencer & Calvin 2002), the ejection of Na and K (Brown et al. 2001; Leblanc et al. 2002), and the sulfur and carbon cycles (Carlson et al. 2009). The possible ejection by the heavy energetic ions of large molecules (Johnson & Sundqvist 2018) that might be suggestive of biologic activity in Europa's ocean will also be briefly reviewed. Both plasma and thermal processes affect the production of the near-surface ambient gas and plasma that have been observed, both remotely and in situ, and might eventually be directly measured by instruments on the Europa Clipper. Although ambient gas-phase O₂ observed is produced by the plasma decomposition of its icy surface, it has been suggested that the near-surface O₂ might be dominated by thermal desorption (Oza et al. 2018; Johnson et al. 2018) and the observed O₂ trapped in bubbles appears to be highly variable (Spencer & Grundy 2018). This would suggest, not surprisingly, that plasma and thermal processing are in some sense symbiotic, which is likely also the case for observed grain sizes (Cassidy et al 2013; Schaible et al. 2016) that affect the thermal inertia and the interpretation of remote sensing data (e.g., Trumbo et al. 2017)

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